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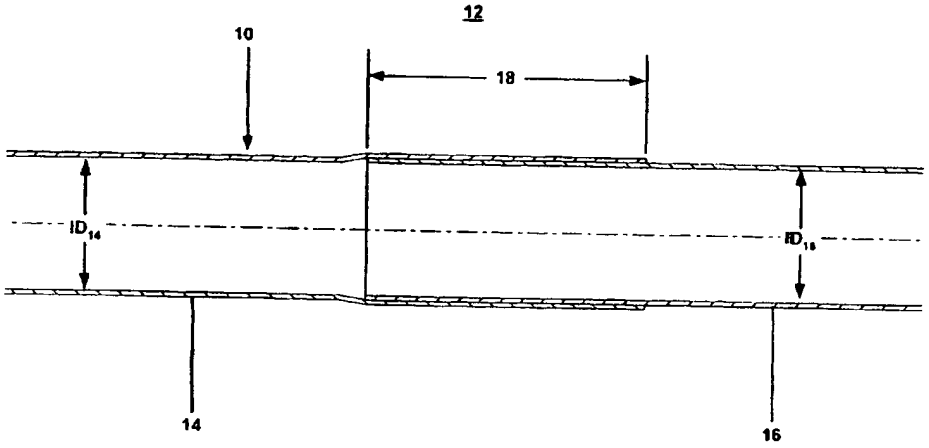
(54) Title: MONO-DIAMETER WELLBORE CASING



(57) Abstract: A mono diameter wellbore casing (14, 16).

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US03/13787

A. CLASSIFICATION OF SUBJECT MATTER
IPC(7) : E21B 19/16
US CL : 166/380,207
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
U.S. : 166/120-122,187,206,207,380,382,387

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
East: (diameter$1 with (casing pipe conduit tub$5))

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6,142,230 A (SMALLEY et al.) 07 November 2000 (07.11.2000), see entire document, especially Figs 6-11.	1-10, 19-36
X	US 6,263,968 B1 (FREEMAN et al.) 24 July 2001 (24.07.2001), see entire document, especially Figs. 4-9.	1, 6
A, P	US.6,497,289 B1 (COOK et al.) 24 December 2002 (24.12.2002), see entire document.	1-36

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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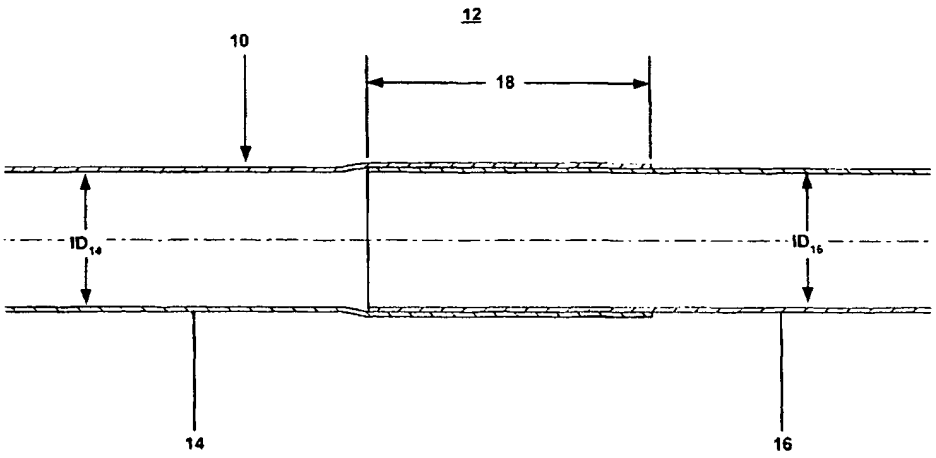

(57) Abstract: A mono diameter wellbore casing (14, 16).

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[received by the International Bureau on 27 July 2004 (27.07.04);
original claims 1-36 replaced by amended claims 1-46 (9 pages)]

What is claimed is:

1. A method of forming a mono diameter wellbore casing within a borehole that traverses a subterranean formation, comprising:

positioning a first wellbore casing within the borehole;

radially expanding and plastically deforming the first wellbore casing within the borehole;

positioning a second wellbore casing within the borehole in overlapping relation to the first wellbore casing;

radially expanding and plastically deforming the second wellbore casing within the borehole;

radially expanding and plastically deforming the overlapping portions of the first and second wellbore casings; and

radially expanding and plastically deforming at least a portion of the second wellbore casing that does not overlap with the first wellbore casing;

wherein the inside diameter of the portion of the first wellbore casing that does not overlap with the second wellbore casing is equal to the inside diameter of the radially expanded and plastically deformed portions of the second wellbore casing.

2. The method of claim 1, wherein radially expanding and plastically deforming the overlapping portions of the first and second wellbore casings comprises:

positioning a telescoping radial expansion device comprising an outer sleeve and an inner sleeve positioned within and movably coupled to the outer sleeve comprising a tubular expansion cone proximate the end of the second wellbore casing; and

injecting a fluidic material into the telescoping radial expansion device to cause the outer sleeve to engage the first wellbore casing and cause the inner sleeve to extend out of the outer sleeve into the overlapping portions of the first and second wellbore casings to cause the tubular expansion cone to radially expand and plastically deform the overlapping portions of the first and second wellbore casings.

3. The method of claim 2, further comprising:

conveying fluidic materials within the borehole that are displaced by the extension of the inner sleeve to a location within the borehole above the tubular expansion cone.

4. The method of claim 2, wherein radially expanding and plastically deforming at least a portion of the second wellbore casing that does not overlap with the first wellbore casing comprises:

reducing the operating pressure within the telescoping radial expansion device;

moving the outer sleeve onto the inner sleeve of the telescoping radial expansion device; and

injecting a fluidic material into the telescoping radial expansion device to cause the outer sleeve to engage at least one of the first and second wellbore casings and cause the inner sleeve to extend out of the outer sleeve into the second wellbore casing to cause

the tubular expansion cone to radially expand and plastically deform at least a portion of the second wellbore casing.

5. The method of claim 4, further comprising:

conveying fluidic materials within the borehole that are displaced by the extension of the inner sleeve to a location within the borehole above the tubular expansion cone.

6. An apparatus for forming a mono diameter wellbore casing, comprising:

means for positioning a first wellbore casing within the borehole;

means for radially expanding and plastically deforming the first wellbore casing within the borehole;

means for positioning a second wellbore casing within the borehole in overlapping relation to the first wellbore casing;

means for radially expanding and plastically deforming the second wellbore casing within the borehole;

means for radially expanding and plastically deforming the overlapping portions of the first and second wellbore casings; and

means for radially expanding and plastically deforming at least a portion of the second wellbore casing that does not overlap with the first wellbore casing;

wherein the inside diameter of the portion of the first wellbore casing that does not overlap with the second wellbore casing is equal to the inside diameter of the radially expanded and plastically deformed portions of the second wellbore casing.

7. The apparatus of claim 6, wherein means for radially expanding and plastically deforming the overlapping portions of the first and second wellbore casings comprises:

means for positioning a telescoping radial expansion device comprising an outer sleeve and an inner sleeve positioned within and movably coupled to the outer sleeve comprising a tubular expansion cone proximate the end of the second wellbore casing; and

means for injecting a fluidic material into the telescoping radial expansion device to cause the outer sleeve to engage the first wellbore casing and cause the inner sleeve to extend out of the outer sleeve into the overlapping portions of the first and second wellbore casings to cause the tubular expansion cone to radially expand and plastically deform the overlapping portions of the first and second wellbore casings.

8. The method of claim 7, further comprising:

conveying fluidic materials within the borehole that are displaced by the extension of the inner sleeve to a location within the borehole above the tubular expansion cone.

9. The apparatus of claim 7, wherein means for radially expanding and plastically deforming at least a portion of the second wellbore casing that does not overlap with the first wellbore casing comprises:

means for reducing the operating pressure within the telescoping radial expansion device;

means for moving the outer sleeve onto the inner sleeve of the telescoping radial expansion

device; and

means for injecting a fluidic material into the telescoping radial expansion device to cause the outer sleeve to engage at least one of the first and second wellbore casings and cause the inner sleeve to extend out of the outer sleeve into the second wellbore casing to cause the tubular expansion cone to radially expand and plastically deform at least a portion of the second wellbore casing.

10. The method of claim 9, further comprising:

conveying fluidic materials within the borehole that are displaced by the extension of the inner sleeve to a location within the borehole above the tubular expansion cone.

11. An apparatus for radially expanding and plastically deforming a tubular member, comprising:

a tubular adapter defining a longitudinal passage;

a tubular outer sleeve coupled to the tubular adapter defining a longitudinal passage;

a tubular hydraulic slip body coupled to the tubular outer sleeve defining a plurality of L-shaped bypass ports and a plurality of radial hydraulic slip mounting passages;

a plurality of hydraulic slips movably coupled and positioned within corresponding radial hydraulic slip mounting passages for engaging the tubular member;

a tubular packer cup mandrel coupled to the tubular hydraulic slip body defining a longitudinal passage;

a plurality of packer cups coupled to the tubular packer cup mandrel for sealingly engaging the tubular member;

a tubular shoe positioned within and movably coupled to the tubular outer sleeve defining a longitudinal passage;

a tubular inner mandrel positioned within and movably coupled to the tubular hydraulic slip body coupled to the tubular shoe defining a longitudinal passage and a plurality of radial bypass ports;

a tubular expansion cone mandrel coupled to the tubular inner mandrel defining a longitudinal passage having a throat passage for receiving a ball, an L-shaped bypass port, and a radial pressure port;

a tubular expansion cone coupled to the tubular expansion cone including a tapered outer expansion surface for radially expanding and plastically deforming the tubular member;

a tubular guide nose coupled to the tubular expansion cone mandrel defining a longitudinal passage;

a bypass tube positioned within the tubular inner mandrel coupled to the expansion cone mandrel and the tubular shoe defining a longitudinal passage; and

an annular longitudinal bypass passage defined between the tubular inner mandrel and the

bypass tube.

12. The apparatus of claim 11, wherein the longitudinal passages of the tubular adapter, bypass tube, and tubular expansion cone mandrel are fluidicly coupled.

13. The apparatus of claim 11, wherein the longitudinal passage of the tubular expansion cone mandrel is fluidicly coupled to the radial pressure port of the tubular expansion cone mandrel.

14. The apparatus of claim 11, wherein the L-shaped bypass port of the tubular expansion cone mandrel is fluidicly coupled to the annular longitudinal bypass passage, the radial bypass passages of the tubular inner mandrel, the L-shaped bypass ports of the tubular hydraulic slip body, and the radial bypass ports of the tubular outer sleeve.

15. An apparatus for radially expanding and plastically deforming a tubular member, comprising:

a tubular support member defining a longitudinal passage;

a tubular outer sleeve coupled to the tubular support member defining a longitudinal passage and a plurality of radial bypass ports;

an hydraulic slip coupled to the tubular outer sleeve for controllably engaging the tubular member;

one or more packer cups coupled to the tubular outer sleeve for sealingly engaging the tubular member;

a tubular inner sleeve positioned within and movably coupled to the tubular outer sleeve defining a longitudinal passage, an annular longitudinal bypass passage, and one or more radial bypass passages; and

a tubular expansion cone coupled to the tubular inner sleeve defining a longitudinal passage having a throat passage for receiving a ball, an L-shaped bypass port, and a radial pressure port including an tapered outer expansion surface for radially expanding and plastically deforming the tubular member.

16. The apparatus of claim 15, wherein the longitudinal passages of the tubular outer sleeve and the tubular expansion cone are fluidicly coupled.

17. The apparatus of claim 15, wherein the longitudinal passage of the tubular expansion cone is fluidicly coupled to the radial pressure port of the tubular expansion cone.

18. The apparatus of claim 15, wherein the L-shaped bypass port of the tubular expansion cone is fluidicly coupled to the annular longitudinal bypass passage and the radial bypass passages of the tubular inner sleeve, and the L-shaped bypass ports and the radial bypass ports of the tubular outer sleeve.

19. A method of radially expanding and plastically deforming a wellbore casing positioned within a borehole that traverses a subterranean formation, comprising:

positioning an outer tubular sleeve and an inner tubular sleeve comprising an expansion cone within the borehole, wherein the inner tubular sleeve is movably coupled to and at

least partially housed within the outer tubular sleeve;

injecting a fluidic material into the inner and outer tubular sleeves;

coupling the outer tubular sleeve to the wellbore casing; and

extending the inner tubular sleeve out of the outer tubular sleeve into the wellbore casing to radially expand and plastically deform a portion of the wellbore casing using the expansion cone.

20. The method of claim 19, wherein injecting a fluidic material into the inner and outer tubular sleeves comprises:

injecting the fluidic material into an annular chamber above the expansion cone.

21. The method of claim 19, further comprising:

conveying fluidic materials within the borehole displaced by the extension of the inner tubular sleeve to a location above the expansion cone.

22. The method of claim 21, wherein conveying fluidic materials within the borehole displaced by the extension of the inner tubular sleeve above the expansion cone comprises:

conveying fluidic materials within the borehole displaced by the extension of the inner tubular sleeve through an annular passage and one or more radial passages to the location above the expansion cone.

23. The method of claim 19, further comprising:

depressuring the inner and outer tubular sleeves;

decoupling the outer tubular sleeve and the wellbore casing; and

collapsing the outer tubular sleeve onto the inner tubular sleeve.

24. The method of claim 23, further comprising:

injecting a fluidic material into the inner and outer tubular sleeves;

coupling the outer tubular sleeve to the wellbore casing;

extending the inner tubular sleeve out of the outer tubular sleeve into the wellbore casing to radially expand and plastically deform another portion of the wellbore casing.

25. The method of claim 24, wherein injecting a fluidic material into the inner and outer tubular sleeves comprises:

injecting the fluidic material into an annular chamber above the expansion cone.

26. The method of claim 24, further comprising:

conveying fluidic materials within the borehole displaced by the extension of the inner tubular sleeve to a location above the expansion cone.

27. The method of claim 26, wherein conveying fluidic materials within the borehole displaced by the extension of the inner tubular sleeve above the expansion cone comprises:

conveying fluidic materials within the borehole displaced by the extension of the inner tubular sleeve through an annular passage and one or more radial passages to the location

above the expansion cone.

28. An apparatus for radially expanding and plastically deforming a wellbore casing positioned within a borehole that traverses a subterranean formation, comprising:

means for positioning an outer tubular sleeve and an inner tubular sleeve comprising an expansion cone within the borehole, wherein the inner tubular sleeve is movably coupled to and at least partially housed within the outer tubular sleeve;

means for injecting a fluidic material into the inner and outer tubular sleeves;

means for coupling the outer tubular sleeve to the wellbore casing; and

means for extending the inner tubular sleeve out of the outer tubular sleeve into the wellbore casing to radially expand and plastically deform a portion of the wellbore casing using the expansion cone.

29. The apparatus of claim 28, wherein means for injecting a fluidic material into the inner and outer tubular sleeves comprises:

means for injecting the fluidic material into an annular chamber above the expansion cone.

30. The apparatus of claim 28, further comprising:

means for conveying fluidic materials within the borehole displaced by the extension of the inner tubular sleeve to a location above the expansion cone.

31. The apparatus of claim 30, wherein means for conveying fluidic materials within the borehole displaced by the extension of the inner tubular sleeve above the expansion cone comprises:

means for conveying fluidic materials within the borehole displaced by the extension of the inner tubular sleeve through an annular passage and one or more radial passages to the location above the expansion cone.

32. The apparatus of claim 28, further comprising:

means for depressuring the inner and outer tubular sleeves;

means for decoupling the outer tubular sleeve and the wellbore casing; and

means for collapsing the outer tubular sleeve onto the inner tubular sleeve.

33. The apparatus of claim 32, further comprising:

means for injecting a fluidic material into the inner and outer tubular sleeves;

means for coupling the outer tubular sleeve to the wellbore casing;

means for extending the inner tubular sleeve out of the outer tubular sleeve into the wellbore casing to radially expand and plastically deform another portion of the wellbore casing.

34. The apparatus of claim 33, wherein means for injecting a fluidic material into the inner and outer tubular sleeves comprises:

means for injecting the fluidic material into an annular chamber above the expansion cone.

35. The apparatus of claim 33, further comprising:

means for conveying fluidic materials within the borehole displaced by the extension of the inner tubular sleeve to a location above the expansion cone.

36. The apparatus of claim 35, wherein means for conveying fluidic materials within the borehole displaced by the extension of the inner tubular sleeve above the expansion cone comprises:

means for conveying fluidic materials within the borehole displaced by the extension of the inner tubular sleeve through an annular passage and one or more radial passages to the location above the expansion cone.

37. An apparatus for radially expanding and plastically deforming a tubular member, comprising:

a tubular adapter defining a longitudinal passage;

a tubular outer sleeve coupled to the tubular adapter defining a longitudinal passage;

a tubular hydraulic slip body coupled to the tubular outer sleeve defining a plurality of bypass ports and a plurality of radial hydraulic slip mounting passages;

a plurality of hydraulic slips movably coupled and positioned within corresponding radial hydraulic slip mounting passages for engaging the tubular member;

a tubular packer cup mandrel coupled to the tubular hydraulic slip body defining a longitudinal passage;

a plurality of packer cups coupled to the tubular packer cup mandrel for sealingly engaging the tubular member;

a tubular shoe positioned within and movably coupled to the tubular outer sleeve defining a longitudinal passage;

a tubular inner mandrel positioned within and movably coupled to the tubular hydraulic slip body coupled to the tubular shoe defining a longitudinal passage and a plurality of radial bypass ports;

an expansion device mandrel coupled to the tubular inner mandrel defining a longitudinal passage having a throat passage for receiving a ball, a bypass port, and a radial pressure port;

an expansion device coupled to the tubular expansion device mandrel including one or more tapered outer expansion surfaces for radially expanding and plastically deforming the tubular member;

a tubular guide nose coupled to the tubular expansion device mandrel defining a longitudinal passage;

a bypass tube positioned within the tubular inner mandrel coupled to the expansion device mandrel and the tubular shoe defining a longitudinal passage; and

an annular longitudinal bypass passage defined between the tubular inner mandrel and the bypass tube.

38. The apparatus of claim 37, wherein the longitudinal passages of the tubular adapter, bypass tube, and tubular expansion cone mandrel are fluidicly coupled.

39. The apparatus of claim 37, wherein the longitudinal passage of the tubular expansion device mandrel is fluidicly coupled to the radial pressure port of the tubular expansion device mandrel.

40. The apparatus of claim 37, wherein the bypass port of the tubular expansion device mandrel is fluidicly coupled to the annular longitudinal bypass passage, the radial bypass passages of the tubular inner mandrel, the bypass ports of the tubular hydraulic slip body, and the radial bypass ports of the tubular outer sleeve.

41. An apparatus for radially expanding and plastically deforming a tubular member, comprising:

a tubular support member defining a longitudinal passage;

a tubular outer sleeve coupled to the tubular support member defining a longitudinal passage and a plurality of radial bypass ports;

an hydraulic slip coupled to the tubular outer sleeve for controllably engaging the tubular member;

one or more packer cups coupled to the tubular outer sleeve for sealingly engaging the tubular member;

a tubular inner sleeve positioned within and movably coupled to the tubular outer sleeve defining a longitudinal passage, an annular longitudinal bypass passage, and one or more radial bypass passages; and

a tubular expansion device coupled to the tubular inner sleeve defining a longitudinal passage having a throat passage for receiving a ball, a bypass port, and a radial pressure port including one or more tapered outer expansion surfaces for radially expanding and plastically deforming the tubular member.

42. The apparatus of claim 41, wherein the longitudinal passages of the tubular outer sleeve and the tubular expansion device are fluidicly coupled.

43. The apparatus of claim 41, wherein the longitudinal passage of the tubular expansion device is fluidicly coupled to the radial pressure port of the tubular expansion device.

44. The apparatus of claim 41, wherein the bypass port of the tubular expansion device is fluidicly coupled to the annular longitudinal bypass passage and the radial bypass passages of the tubular inner sleeve, and the bypass ports and the radial bypass ports of the tubular outer sleeve.

45. An apparatus for radially expanding and plastically deforming a tubular member, comprising:

a tubular adapter defining a longitudinal passage;

a tubular outer sleeve coupled to the tubular adapter defining a longitudinal passage;

a tubular hydraulic slip body coupled to the tubular outer sleeve defining a plurality of radial hydraulic slip mounting passages;

a plurality of hydraulic slips movably coupled and positioned within corresponding radial hydraulic slip mounting passages for engaging the tubular member;

a tubular packer cup mandrel coupled to the tubular hydraulic slip body defining a longitudinal passage;

a plurality of packer cups coupled to the tubular packer cup mandrel for scalingly engaging the tubular member;

a tubular inner mandrel positioned within and movably coupled to the tubular hydraulic slip body coupled to the tubular shoe defining a longitudinal passage and a plurality of bypass ports;

an expansion device mandrel coupled to the tubular inner mandrel defining a longitudinal passage, a bypass port, and a radial pressure port; and

an expansion device coupled to the tubular expansion device mandrel including one or more tapered outer expansion surfaces for radially expanding and plastically deforming the tubular member.

46. An apparatus for radially expanding and plastically deforming a tubular member, comprising:

a tubular support member defining a longitudinal passage;

a tubular outer sleeve coupled to the tubular support member defining a longitudinal passage and a plurality of radial bypass ports;

an hydraulic slip coupled to the tubular outer sleeve for controllably engaging the tubular member;

one or more packer cups coupled to the tubular outer sleeve for scalingly engaging the tubular member;

a tubular inner sleeve positioned within and movably coupled to the tubular outer sleeve defining a longitudinal passage, an annular longitudinal bypass passage, and one or more radial bypass passages; and

a tubular expansion device coupled to the tubular inner sleeve defining a longitudinal passage having a throat passage for receiving a ball, a bypass port, and a radial pressure port including one or more tapered outer expansion surfaces for radially expanding and plastically deforming the tubular member.